

THE GREAT GLAZE STORM OF FEBRUARY 21-23, 1922, IN THE UPPER LAKE REGION.

DISCUSSION OF GENERAL CONDITIONS.

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An intense glaze storm occurred on February 21-23 in portions of the upper Mississippi Valley and in the States of Wisconsin and Michigan, in which a very large amount of damage was done to overhead telegraph, telephone, and other electrical transmission lines in the regions mentioned. A more serious loss, in an æsthetic sense, was sustained by shade and ornamental trees and orchards in the States named, a loss which can not be replaced within the lifetime of the present generation.

The present winter has been rather exceptional in that 4, possibly 5, severe glaze storms have occurred in rather widely separated parts of the country.¹ These storms appear to have had one common point in their origin, viz, that of a cold surface air current being overrun by a warmer current. The latter being thus elevated and its moisture condensed, as rain which, falling upon objects having a temperature some degrees below 32° F., is frozen as it reaches them. The Michigan-Wisconsin storm was exceptional in its duration and the amount of precipitation in the form of rain which occurred; it was also exceptional in the fact that it occurred in very nearly the geographical center of the continent, farther north than is usual for such storms in February.

ANTECEDENT WEATHER CONDITIONS.

Pressure distribution February 20.—An anticyclone of considerable magnitude whose longer axis extended from Chicago, Ill., to Bismarck, N. Dak., was moving rather rapidly eastward. Surface winds over Iowa, Missouri, eastern Nebraska, and eastern Kansas, were from the northeast due to the position of the anticyclone. A cyclonic area of wide geographic extent with its center over Nevada dominated the winds west of the Rockies.

Free-air winds on 20th.—Free-air observations by means of kites and pilot balloons were made at so few places that the picture afforded by them is incomplete. A kite flight at Drexel, Nebr., gave surface winds from the northeast, shifting to south at 1,104 meters above the surface, southwest at 1,604 meters west-southwest at 2,104 meters and to west at 2,604 meters continuing from that direction up to the top of the flight at 3,910 meters where the velocity was 23.6 meters per second. Pilot balloon flights on the afternoon of the same date show southwest or south-southwest winds at the 1,500 meter level at Dayton, Ohio, and also at Broken Arrow, Okla. Thus it would seem that as a result of the interaction of the anticyclonic and cyclonic systems above mentioned, southwest winds were merging with a strong westerly current at and above 4 kilometers.

Pressure distribution, February 21.—The anticyclone above mentioned continued its eastward movement preserving its conformation unchanged; the longer axis now extended from Albany, N. Y., to Sault Ste. Marie, Mich., and a second strong anticyclone appeared in the Canadian Northwest so that an unbroken area of high pressure and associated low temperature extended from eastern New York to Alberta, while the western cyclone still occupied the region from the Rockies to the Pacific but its influence now extends over the Plains States and into the upper Mississippi Valley. The surface winds over Iowa, Missouri, eastern part of Nebraska and Kansas, which on the previous day had been northeasterly are now southeasterly and rain or snow has set in over southern Iowa and northwestern Illinois. The temperature contrast between Iowa and upper Michigan is sharp, viz, from 30° in the former to zero in northern Michigan.

Efforts to penetrate the very extensive cloud blanket which shrouded this region were generally unsuccessful. At Drexel, Nebr., the kites collapsed at 816 meters above the surface in a south wind. At Ellendale, N. Dak., the wind was southeast at 556 meters and thence to the top of the flight which ended at 768 meters in conditions of extreme severity approaching that of a "blizzard." At Royal Center, Ind., farther south, surface winds were southeast becoming south at 775 meters above the surface; southwest at 1,775 meters, west-southwest at 2,275 meters, and continuing in that direction to the top of the flight which ended at 3,303 meters where the kites collapsed in the rain which had continued throughout the flight.

The southwest wind noted on the previous day at Drexel, Nebr., thus appears at about the same level at Royal Center, about 600 miles east of the first named, and here too it merged into a west wind at higher levels. To the east and south of the cloud-covered area pilot balloon flights show southerly winds generally as far south as the Gulf of Mexico, but not at levels above 1,500 meters, except as far west as Denver, Colo. The point we wish to emphasize is that doubtless there was a warm southerly current above the colder easterly current throughout the region where intense glaze prevailed.² As the center of the western cyclone approached the Mississippi Valley the surface temperature rose and accordingly the area exposed to the conditions which produced intense glaze is found farther to the northward than on the preceding day. This is shown graphically in figure 1.

¹ Cf. Melsinger, C. Le Roy: Precipitation of sleet and the formation of glaze in the eastern United States, Jan. 26-28, 1920, with remarks on forecasting. *Mo. WEATHER REV.*, February, 1920, pp. 73-80.

² *Mo. WEATHER REV.*, November, 1921, 49: 612; December, p. 661.